

## Supplemental Network Description

### Port Angeles Citywide 4.9 GHz Public Safety Broadband Wireless

The City of Port Angeles is implementing a citywide broadband wireless network project that will provide integrated communications and interoperability among all local public safety entities.<sup>1</sup> The construction of this 4.9 GHz public safety network represents the culmination of years of planning, and the allocation of considerable federal and local funding: The projected cost of the network is approximately \$4.0 million, 70 percent of which is being funded by a grant under the federal Recovery Act's Broadband Technology Opportunities Program (BTOP).

**Figure 1: 4.9 GHz Project Funded by Federal Recovery Act Grant**



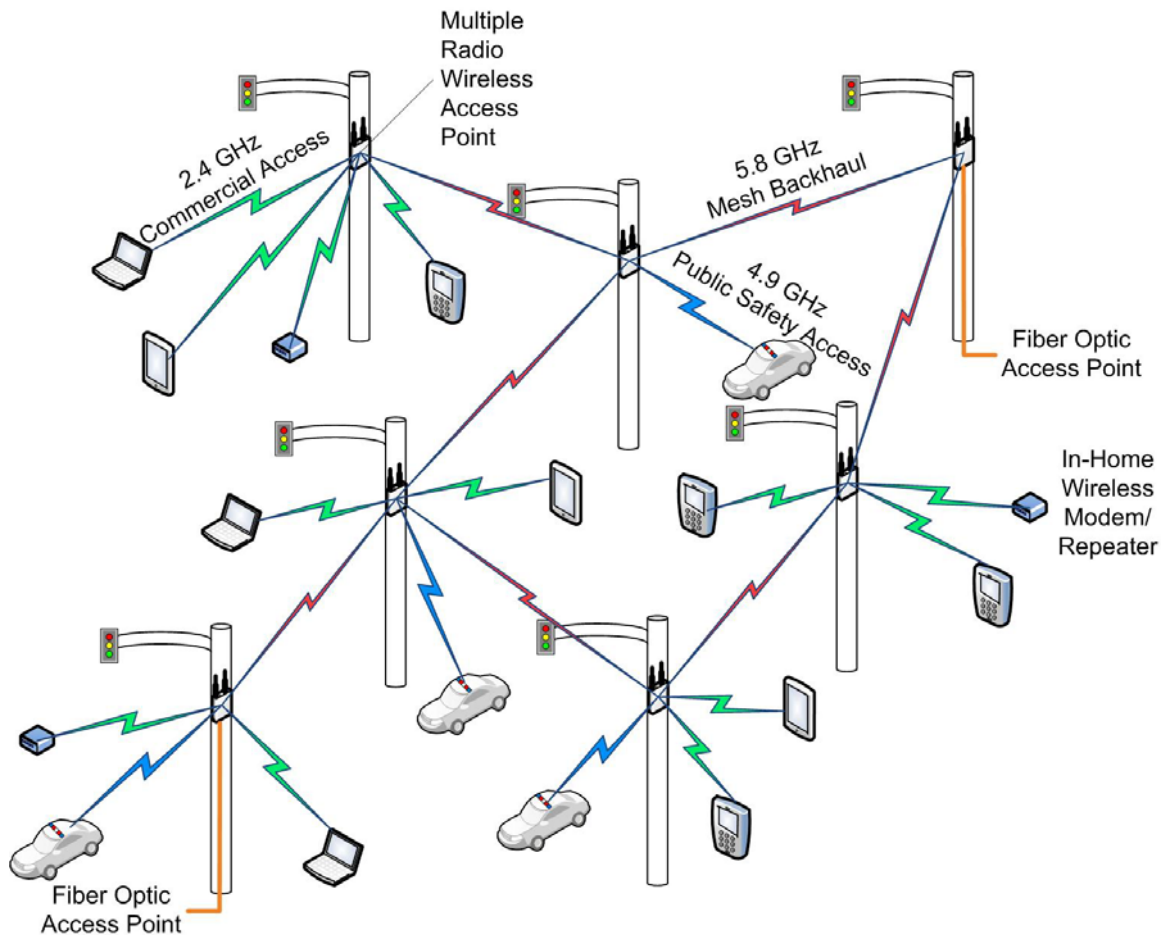
This network allows the City to leverage a range of in-place public and private broadband assets and initiatives to deliver essential communications services to first responders in the field and the public at large.

The network's 234 dual-band wireless access points (WAP) are interconnected to an existing fiber optic backbone that connects City, county, and other public safety entities, City utility facilities, and City government departments (which collectively operate on the 4.9 GHz public safety band), as well as commercial Wi-Fi subscribers (which operate on the 2.4 GHz band). The wireless access points form a wireless mesh using the 5.8 GHz band, which serves as backhaul between access points.

---

<sup>1</sup> City of Port Angeles Police Department, area fire departments, Clallam County Sheriff, and the Elwha Nation public safety department

**Figure 2: Wireless System Architecture**



The wireless access points are installed on City-owned utility and light poles throughout the City. The wireless access points are strategically placed at intervals of approximately 1,200 feet to provide reliable outdoor and mobile coverage as well as indoor coverage with an in-home wireless modem/repeater. Approximately 40 of the wireless access points are tied into the fiber optic network, providing backhaul to the surrounding wireless mesh of access points. The network was designed to only require a maximum of two 5.8 GHz wireless hops to reach a fiber access point.

### **Project Benefits**

On the top of the City's list of priorities is the public safety community's need to deliver interoperable high-bandwidth mobile data communications to first responders in the field, allowing them to access critical and time-sensitive information on site. The high-capacity broadband wireless network provides public safety staff in the field with full and timely access to state, federal, and GIS databases, and will allow EMS responders to access medical databases and support on-site telemetry of patient status. Our initial tests indicate that we are able to support data transport speeds in excess of 10 Mbps to vehicles traveling at a speed of 60 mph.

A citywide wireless broadband footprint also provides a timely and cost-effective mechanism to interconnect, monitor, and control all of the many distributed elements of the City's complex electrical, water, storm water, and wastewater facilities. In addition to providing backbone control, the density of coverage will allow cost-effective future deployment of Smart Grid technology throughout the City.

The addition of wireless PC devices to utility and other City vehicles associated with permitting and building and electrical site inspections will improve staff efficiency by allowing managers to send work orders directly to staff in the field. Maintenance staff will also have full online access to design documents and maps in the field, reducing the need for in-office support and trips back to the shop.

In addition to these public sector benefits, the project also enables the availability of community broadband. A commercial "open access" multi-provider wireless access system was deployed as a public-private partnership with a local Internet service provider (ISP); it provides citywide WiFi services in the 2.4 GHz band. The City and the local ISP partner have developed a subscription package that is attractive to a wide range of commercial, residential, and public sector users. A subsidized service program will be established to provide a "basic broadband lifeline" service to residents who are unable to subscribe due to economic hardship.

### **City Profile**

The City of Port Angeles is the county seat of Clallam County, Washington. Port Angeles had a population of 19,309 residents (2010) occupying 8,053 housing units in a 10.7-square-mile area. While the City is a major center of commerce in northwestern Washington and has a substantial downtown retail district, for purposes of the BTOP grant definition, Port Angeles falls within a rural classification.

Port Angeles plays host to an international port-of-entry, and the regular ferry service that connects the region to Victoria and Vancouver, British Columbia is a primary gateway for tourists entering Canada or entering the US from Canada. (In December 1999, U.S. customs agents arrested a man who arrived on the ferry with a car that carried several pounds of explosives concealed in its trunk. The man was convicted in April 2001 of conspiracy to commit an international terrorist act, among other counts; his intended target had been Los Angeles International Airport.) The City also counts a community college and a regional hospital among its anchor institutions.

In addition to its economic development needs, Port Angeles is statistically under-policed; the Washington State average is 2.07 officers per thousand residents, but Port Angeles has only 1.65 officers per thousand residents. The police department has established innovative programs to address this need by placing resource officers in schools and the downtown district.

### Network Architecture

The wireless network addition to the City's existing broadband infrastructure leverages the power grid/street light infrastructure owned and operated by the Public Works and Utilities Department. Multi-band, broadband mesh wireless access points (WAP) have been installed on and are powered by existing lighting standards. The WAPs are mounded 22 feet high on the lighting standards to provide high-capacity coverage in both consumer and public safety wireless bands. (See photos in Figure 3.)

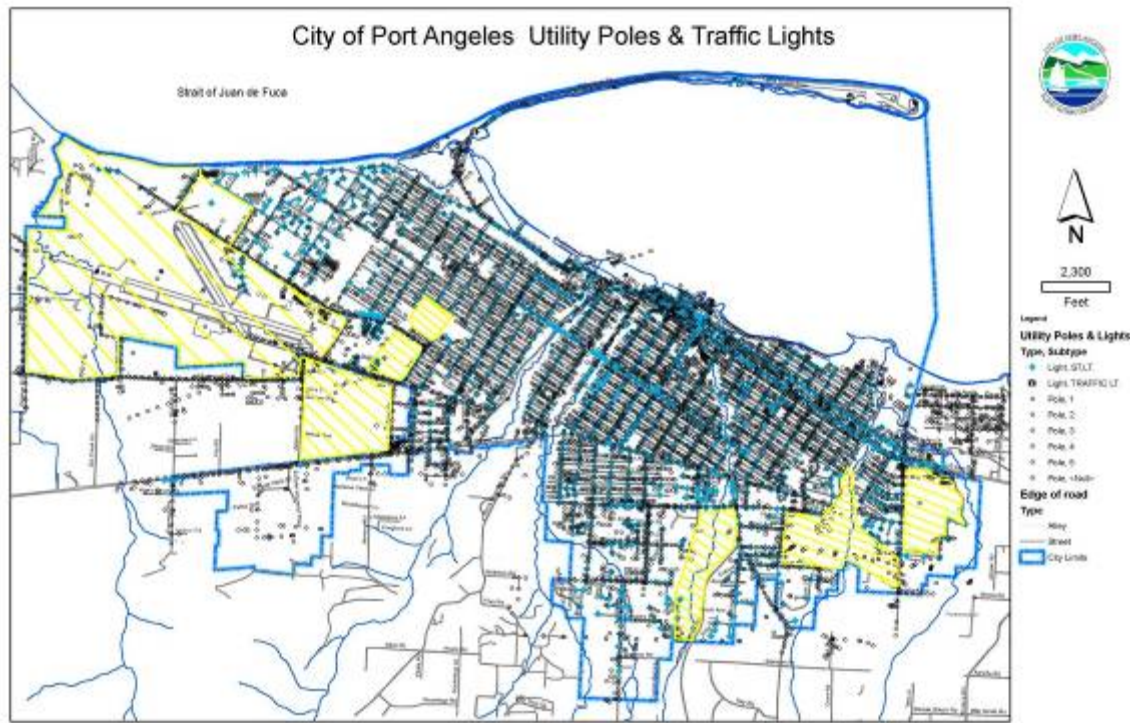
**Figure 3: Wireless Access Point**



The density of access devices was planned based on the desired coverage requirements and subscriber demand requirements. High-capacity areas, such as Route 101 through the City, require an access unit density of 30 to 35 units per square mile (or, in route terms, five to seven units per linear mile). The design targeted a maximum of two mesh access points linked wirelessly to any fiber access point in the high-density and high-traffic areas of the City.

Figure 4 provides an overview of coverage and details of the locations of lighting standards that were available to the City for mounting the WAPs.<sup>2</sup>

**Figure 4: Map of Potential Wireless Access Coverage and Exclusion Areas**



The engineering design focused on providing mobile coverage to over 80 percent of the City's 10.7 square miles (with the exception of the area delineated in yellow on the map) for a total service area of eight square miles. The network was designed to provide service along most or all of the public roads. A secondary or reduced service is available in the unpopulated areas and on the airport land and runways.

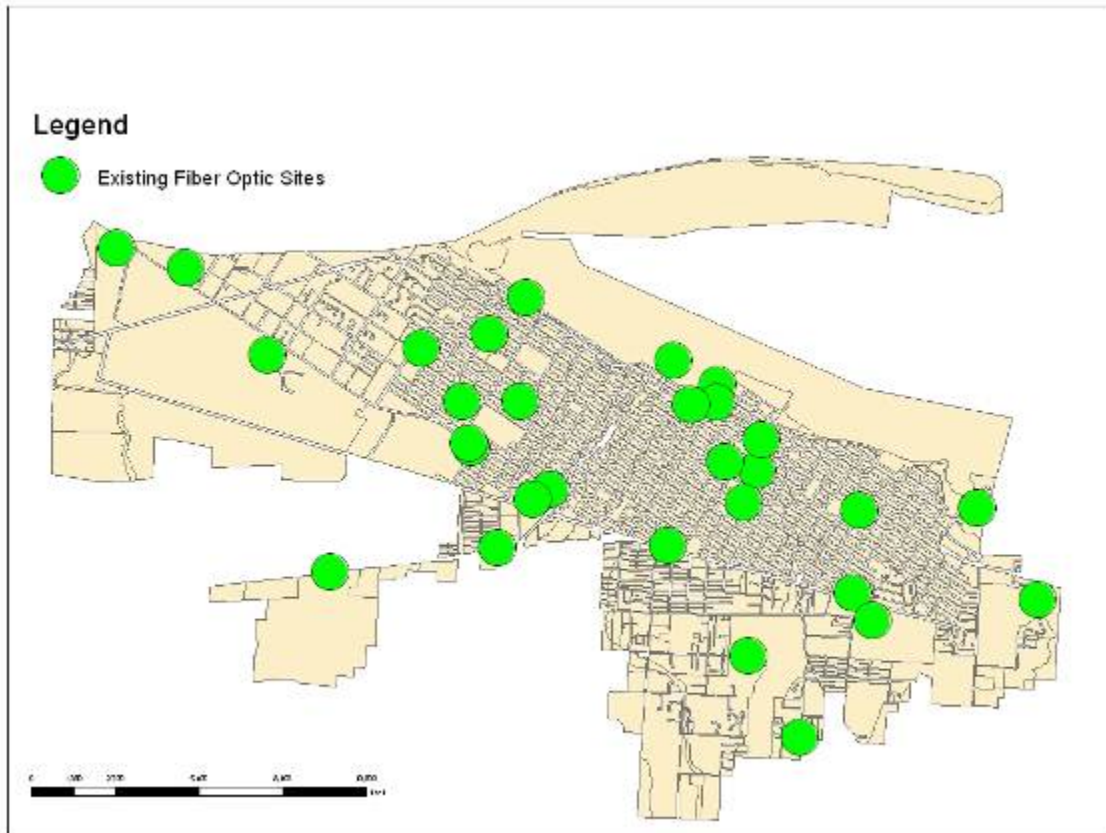
The WAPs are backhauled over fiber optics through the City's 41 high-speed broadband access points (e.g., City buildings, utility SCADA, cameras, and similar facilities), which are distributed throughout the City. Some of these access points were in place prior to the network construction, but some have been added at strategic locations which will allow for direct broadband access for the WAPs and also support other municipal applications such as enhanced utility management functions, advanced metering infrastructure (AMI)/automatic meter reading (AMR) for residential and commercial customers, street

<sup>2</sup> This map is maintained in a GIS database.



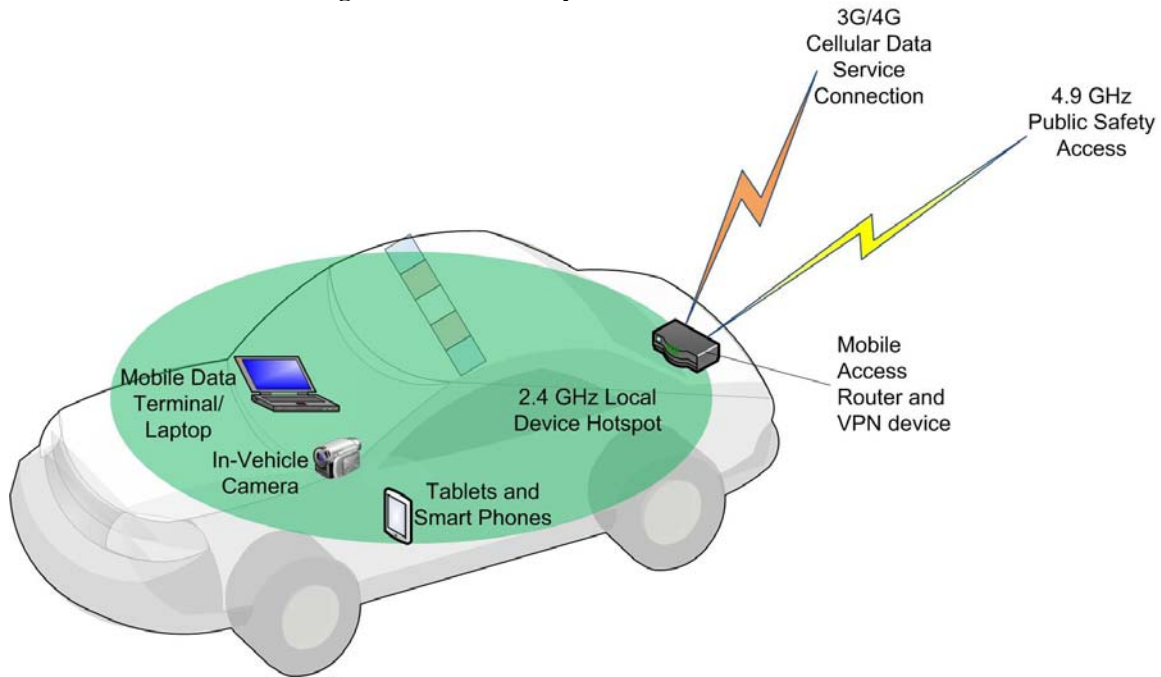
lights, traffic signals, and other facilities. To further enhance the network and provide adequate capacity for the additional broadband traffic, the City will be upgrading the network interface equipment at City Hall and six other key sites. Figure 5 provides an overview of the existing fiber access points that will be used for backhaul.

**Figure 5: Location of Existing Broadband Network Access Points**



Public safety wireless access is provided exclusively using the 4.9 GHz band. Each mobile vehicle is equipped with a mobile access router and VPN device that provides secure connectivity back into the Port Angeles network. The mobile router is equipped with both a 3G/4G cellular data service card and a 4.9 GHz card. The mobile access radio switches between the two networks depending on network availability. For example, when public safety vehicles are outside of the City, the mobile access router will use the 3G/4G service for connectivity. Once the vehicle is back within range of the 4.9 GHz network, the router will switch back over to the 4.9 GHz network. The router handles network sessions between the two networks so that public safety users do not notice roaming between networks. The VPN portion of the router ensures that all data between the public safety vehicle and the Port Angeles network is secure.

**Figure 6: Public Safety Vehicle Network Access**



Within the public safety vehicle, a secure 2.4 GHz hotspot provides connectivity to devices. This hotspot can provide connectivity for mobile data terminals, laptops, in-vehicle cameras, and other network-connectable devices. The hotspot extends several hundred feet beyond the immediate vehicle and can be used to connect other devices at an incident scene.